In the Claims:

1. (Previously Presented) An optical intensity control system for use with an optical switch providing individual signal paths between a plurality of input ports and a plurality of output ports, said optical switch having a plurality of wavelength division multiplexers for combining sets of individual switched optical signals into multiplexed switched optical signals, the system comprising:

a plurality of optical splitters, each optical splitter being connectable to an output of a respective one of the plurality of wavelength division multiplexers;

a plurality of variable optical intensity controllers (VOICs) for insertion into respective ones of the individual signal paths and for individually controlling the intensity of optical signals present in said respective ones of the individual signal paths in accordance with respective intensity control signals; and

an equalizer connected to the plurality of optical splitters and to the plurality of VOICs, for producing an estimate of optical power of each individual switched optical signal and generating the intensity control signals as a function of the estimates of optical power.

2. (Previously Presented) The optical intensity control system as claimed in claim 1, wherein the equalizer comprises:

for each of the plurality of optical splitters, a wavelength division demultiplexer connected to an output of said optical splitter;

for each wavelength division demultiplexer, a plurality of optical receivers connected to said wavelength division demultiplexer;

for each of the plurality of optical receivers, a power estimator connected thereto; and

a common controller connected to each power estimator;

said common controller being adapted to read a power estimate from each power estimator and to generate said intensity control signals as a function thereof.

3. (Original) A system as claimed in claim 2, wherein each optical receiver is a narrow-optical-bandwidth optical receiver tuned to a single optical wavelength.

4. (Original) A system as claimed in claim 1, wherein the equalizer comprises:

a front end circuit having a plurality of inputs for receiving the multiplexed switched optical signals, the front end circuit being adapted to controllably isolate individual switched optical signals from the multiplexed switched optical signals;

an optical receiver unit connected to the front end circuit, for converting any isolated individual switched optical signals to electrical signals;

a power estimation unit connected to the optical receiver unit, for time-averaging the electrical signals, thereby to obtain respective estimates of optical power; and

a processor connected to the power estimated unit and to the front end circuit, the processor being adapted to cause the front end circuit to isolate selected individual switched optical signals, the processor being further adapted to generate the intensity control signals from the estimates of optical power.

5. (Original) A system as claimed in claim 4, wherein the front end circuit comprises, for each of the optical splitters, a wavelength-tunable optical bandpass filter connected to an output of said splitter;

wherein the processor is further adapted to selectably tune the filters in order to cause the selected individual switched optical signals to be isolated.

6. (Original) A system as claimed in claim 1, wherein the front end circuit comprises:

an optical switch matrix having a plurality of inputs respectively connected to the plurality of splitters and having a plurality of controllable erectable mirrors; and

a wavelength division demultiplexer connected to an output of said switch matrix;

wherein the processor is further adapted to selectably raise one mirror at a time on the optical switch matrix in order to cause selected individual switched optical signals to be isolated.

7. (Original) A system as claimed in claim 6, wherein the optical receiver unit comprises narrow-optical-bandwidth optical receivers each tuned to a single, distinct optical wavelength.

8. (Original) A system as claimed in claim 1, wherein the front end circuit comprises:

a first optical switch matrix having a plurality of inputs respectively connected to the plurality of splitters and having a plurality of controllably erectable mirrors;

a wavelength division demultiplexer connected to an output of said first switch matrix; and

at least one second optical switch matrix, each said second optical switch matrix having a plurality of inputs connected to the wavelength division demultiplexer and having a plurality of controllable erectable mirrors;

wherein the processor is further adapted to selectably raise one mirror at a time on the first optical switch matrix and to raise one mirror at a time on the at least one second optical switch matrix in order to cause selected individual switched optical signals to be isolated.

9. (Original) A system as claimed in claim 1, wherein the front end circuit comprises:

a first optical switch matrix having a plurality of inputs respectively connected to the plurality of splitters and having a plurality of controllable erectable mirrors;

a wavelength division demultiplexer connected to an output of said first switch matrix;

at least one second optical switch matrix, each said second optical switch matrix having a plurality of inputs connected to the wavelength division demultiplexer and having a plurality of controllably erectable mirrors; and

a coupler connected to an output of each second optical switch matrix;

wherein the processor is further adapted to selectably raise one mirror at a time on the first optical switch matrix and to raise one mirror at a time on the at least one second optical switch matrix in order to cause selected individual switched optical signals to be isolated.

10. (Original) A system as claimed in claim 1, wherein the front end circuit comprises:

an optical switch matrix having a plurality of inputs respectively connected to the plurality of splitters and having a plurality of controllably erectable mirrors; and

a wavelength-tunable optical bandpass filter connected to an output of said optical switch matrix;

wherein the processors is further adapted to selectably tune the filter and to selectably raise one mirror at a time on the optical switch matrix in order to cause selected individual switched optical signals to be isolated.

11. (Original) A system as claimed in claim 2, wherein the intensity control signals are produced sequentially as a time-division-multiplexed intensity control signal, the equalizer further comprising:

a demultiplexer having a data input and a control input both connected to the processor and having a plurality of outputs, for receiving the time-division-multiplexed intensity control signal at the data input for controllably distributing time-based portions of the time-division-multiplexed intensity control signal to selected ones of its outputs as a function of the signal received at its control input; and

a latching circuit having a plurality of inputs connected to the outputs of the demultiplexer, a plurality of outputs connected to the VOICs and a control input connected to the processor, for transferring the value at any one of its inputs to the corresponding output in response to the signal received at its control input and subsequently holding that value.

12. (Original) A system as claimed in claim 4, further comprising:

a reference path having a reference optical receiver connected in series with a reference power estimation unit, the reference power estimation unit having an output connected to the processor; and

a reference light source for controllably emitting light having a selectable wavelength, the output of the reference light source being coupled to each multiplexed switched optical signal at the input of the front end circuit and also being coupled to an input of the reference optical receiver.

13. (Original) A system as claimed in claim 12, wherein the reference light source is connected to the processor and wherein the processor is further adapted to:

obtain from the reference power estimation unit a reference estimate of the optical power of the reference light course while bypassing the front end circuit;

apply control to the front end circuit in order to obtain an estimate of the optical power of the reference light source for each combination of a multiplexed switched optical signal and a wavelength on that signal;

determine a calibration factor for each said combination by evaluating a function of the reference estimate and the power estimate corresponding to said combination; and

adjust the intensity control signal associated with each switched individual optical signal by the calibration factor associated with the particular combination of multiplexed switched optical signal and wavelength corresponding to that switched individual optical signal.

14. (Original) A system as claimed in claim 12, wherein said reference light source is tunable under control of the processor.

15. (Previously Presented) A method of generating control signals for adjusting intensity of single-carrier optical signals travelling through an optical switch adapted to recombine groups of switched optical signals into multiplexed switched optical signals at an output end of the optical switch, the method comprising the steps of:

(a) controllably isolating individual switched optical signals from the multiplexed switched optical signals;

(b) estimating the power of the individual switched optical signals isolated at step (a); and

(c) generating the control signals as a function of power estimates obtained at step (b) and a reference value.

16. (Previously Presented) The method as claimed in claim 15, further comprising adjusting each control signal as a function of a wavelength and the multiplexed switched optical signal associated with the corresponding isolated signal.

17. (Original) A method as claimed in claim 15, further comprising the steps of:

in advance of a connection map change affecting a subset of said single-carrier optical signals, generating control signals for gradually decreasing the intensity of the affected signals to a nominal value; and

following said connection map change, generating control signals for gradually increasing the intensity of the affected signals to the reference value.

18. (Original) A method as claimed in claim 15, further comprising the steps of:

in advance of a connection map change affecting a subset of said single-carrier optical signals, generating control signals for decreasing, to a nominal value, the intensity of the affected signals in groups thereof; and

following said connection map change, generating control signals for increasing, to the reference value, the intensity of the affected signals in groups thereof.

19. (Previously Presented) An equalizer for generating control signals used in adjusting the intensity of single-carrier optical signals travelling through an optical switch adapted to recombine groups of individual switched optical signals into multiplexed switched optical signals at an output end of the optical switch, the equalizer comprising:

first means for controllably admitting individual switched optical signals from the multiplexed switched optical signals;

second means, connected to the first means, for estimating the power of the admitted individual switched optical signals; and

means, connected to the second means, for generating the control signals as a function of the power estimates and a reference value.

20. (Original) A switch for optical signals, comprising:

a plurality of wavelength division demultiplexers, each having a demultiplexer input port and a plurality of demultiplexer output ports;

a plurality of wavelength division multiplexers, each having a plurality of multiplexer input ports and a multiplexer output port;

a plurality of optical splitters, each being connected to the multiplexer output port of a respective one of the wavelength division multiplexers;

a switching core connected between the wavelength division demultiplexers and the wavelength division multiplexers, for providing an optical path from each demultiplexer output port to any one of a corresponding plurality of the multiplexer input ports;

a plurality of variable optical intensity controllers (VOICs) positioned in respective ones of the optical paths, each VOIC being arranged to control the intensity of a narrow-optical-bandwidth optical signal present in the respective optical path in accordance with a respective intensity control signal; and

an equalizer connected to the couplers and to the VOICs, for producing an estimate of the optical power of each narrow-optical-bandwidth optical signal after switching by the switching core and for generating the intensity control signals as a function of the estimates of optical power.

21. (Original) A switch as claimed in claim 20, wherein the VOICs are positioned between the switching core and the wavelength division multiplexers.

22. (Original) A switch as claimed in claim 20, wherein the VOICs are positioned between the wavelength division demultiplexers and the switching core.

23. (Original) A switch as claimed in claim 20, wherein the equalizer comprises:

for each of the optical splitters, a corresponding wavelength division demultiplexer connected to an output of said splitter;

for each wavelength division demultiplexer in the equalizer, a plurality of optical receivers connected to said demultiplexer;

for each optical receiver, a power estimator connected thereto; and

a common controller connected to each power estimator;

said controller being adapted to read a power estimate from each power estimator and to generate said intensity control signals as a function thereof.

24. (Original) A switch as claimed in claim 23, wherein each optical receiver is a narrow-optical-bandwidth optical receiver tuned to a single optical wavelength.

25. (Original) A switch as claimed in claim 20, wherein the equalizer comprises:

for each of the optical splitters, a corresponding wavelength-tunable optical bandpass filter connected to an output of said splitter;

for each filter, a corresponding wide-optical-bandwidth optical receiver connected thereto;

for each optical receiver, a corresponding power estimator connected thereto; and

a controller connected to the power estimators and to the filters;

said controller being adapted to selectably tune the filters, to read power estimates from the power estimators and to generate said intensity control signals as a function of the power estimates.

26. (Original) A switch as claimed in claim 20, wherein the equalizer comprises:

an optical switch matrix having a plurality of inputs respectively connected to the plurality of splitters and having a plurality of controllably erectable mirrors;

a wavelength division demultiplexer connected to an output of said switch matrix;

a plurality of optical receivers connected to said demultiplexer in the equalizer;

a plurality of power estimators respectively connected to the plurality of optical receivers; and

a controller being adapted to selectably raise one mirror at a time on the optical switch matrix, to read power estimates from the power estimators and to generate said intensity control signals as a function of the power estimators.

27. (Original) A switch as claimed in claim 26, wherein each optical receiver is a narrow-optical-bandwidth optical receiver tuned to a single optical wavelength.

28. (Original) A switch as claimed in claim 26, wherein the switching core comprises a plurality of core optical switching matrixes, each core optical switch matrix being associated with a distinct optical wavelength.

29. (Original) A switch as claimed in claim 28, wherein the switching core further comprises a wavelength-converting inner-matrix switch connected to the core optical switching matrices, for receiving optical signals from the core optical switching matrices, converting each received optical signal to electrical form and transmitting each converted signal at a changed wavelength to the core optical switch matrix associated with the changed wavelength.

30. (Original) A switch as claimed in claim 29, wherein at least one optical switch matrix in the equalizer is in a stacked relationship with respect to one or more core optical switch matrices.

31. (Original) A switch as claimed in claim 30, wherein at least one optical switch matrix in the equalizer is parallel to and aligned with one or more core optical switch matrices.

32. (Original) A switch as claimed in claim 20, wherein the equalizer comprises:

a first optical switch matrix having a plurality of inputs respectively connected to the plurality of splitters and having a plurality of controllably erectable mirrors;

a wavelength division demultiplexer connected to an output of said first switch matrix;

at least one second optical switch matrix, each said second optical switch matrix having a plurality of inputs connected to the wavelength division demultipexer in the equalizer and having a plurality of controllably erectable mirrors;

for each second optical switch matrix, a corresponding optical receiver connected to an output thereof;

for each optical receiver, a corresponding power estimator connected thereto; and

a controller connected to the power estimators, to the first optical switch matrix and to the at least one second optical switch matrix;

said controller being adapted to selectably raise one mirror at a time on the first optical switch matrix, to raise one mirror at a time on the at least one second optical switch matrix, to read power estimates from the power estimators and to generate said intensity control signals as a function of the power estimates.

33. (Original) A switch as claimed in claim 32, wherein the switching core comprises a plurality of core optical switching matrices, each core optical switch matrix being associated with a distinct optical wavelength.

34. (Original) A switch as claimed in claim 33, wherein the switching core further comprises a wavelength-converting inner-matrix switch connected to the core optical switching matrices, for receiving optical signals from the core optical switching matrices, converting each received optical signal to electrical form and transmitting each converted signal at a changed wavelength to the core optical switch matrix associated with the changed wavelength.

35. (Original) A switch as claimed in claim 34, wherein at least one optical switch matrix in the equalizer is in a stacked relationship with respect to one or more core optical switch matrices.

36. (Original) A switch as claimed in claim 34, wherein at least one optical switch matrix in the equalizer is parallel to and aligned with one or more core optical switch matrices.

37. (Original) A switch as claimed in claim 20, wherein the equalizer comprises:

a first optical switch matrix having a plurality of inputs respectively connected to the plurality of splitters and having a plurality of controllably erectable mirrors;

a wavelength division demultiplexer connected to an output of said first switch matrix;

at least one second optical switch matrix, each said second optical switch matrix having a plurality of inputs connected to the wavelength division demultiplexer in the equalizer and having a plurality of controllably erectable mirrors;

a coupler connected to an output of each second optical switch matrix;

a wide-optical-bandwidth optical receiver connected to the coupler;

a power estimator connected to said optical receiver; and

a controller connected to the power estimator, to the first optical switch matrix and to the at least one second optical switch matrix;

said controller being adapted to selectably raise one mirror at a time on the first optical switch matrix, to raise one mirror at a time on the at least one second optical switch matrix, to read power estimates from the power estimator and to generate said intensity control signals as a function of the power estimates.

38. (Original) A switch as claimed in claim 37, wherein the switching core comprises a plurality of core optical switching matrices, each core optical switch matrix being associated with a distinct optical wavelength.

39. (Original) A switch as claimed in claim 38, wherein the switching core further comprises a wavelength-converting inter-matrix switch connected to the core optical switching matrices, for receiving optical signals from the core optical switching matrices, converting each received

signal to electrical form and transmitting each converted signal at a changed wavelength to the core optical switch matrix associated with the changed wavelength.

40. (Original) A switch as claimed in claim 39, wherein at least one optical switch matrix in the equalizer is in a stacked relationship with respect to one or more core optical switch matrices.

41. (Original) A switch as claimed in claim 39, wherein at least one optical switch matrix in the equalizer is parallel to and aligned with one or more core optical switch matrices.

42. (Original) A switch as claimed in claim 20, where the equalizer comprises:

an optical switch matrix having a plurality of input respectively connected to the plurality of splitters and having a plurality of controllably erectable mirrors;

a wavelength-tunable optical bandpass filter connected to an output of said optical switch matrix;

a wide-optical-bandwidth optical receiver connected to said filter;

a power estimator connected to said optical receiver; and

a controller connected to the power estimator, to the filter and to the optical switch matrix;

said controller being adapted to selectably tune the filter, to selectably raise one mirror at a time on the optical switch matrix, to read power estimates from the power estimator and to generate said intensity control signals as a function of the power estimates.

43. (Original) A switch as claimed in claim 42, wherein the switching core comprises a plurality of core optical switching matrices, each core optical switch matrix being associated with a distinct optical wavelength.

44. (Original) A switch as claimed in claim 43, wherein the switching core further comprises a wavelength-converting inter-matrix switch connected to the core optical switching matrices, for receiving optical signals from the core optical switching matrices, converting each received signal to electrical form and transmitting each converted signal at a changed wavelength to the core optical switch matrix associated with the changed wavelength.

45. (Original) A switch as claimed in claim 44, wherein at least one optical switch matrix in the equalizer is in a stacked relationship with respect to one or more core optical switch matrices.

46. (Original) A switch as claimed in claim 44, wherein at least one optical switch matrix in the equalizer is parallel to and aligned with one or more core optical switch matrices.

47. (Original) A switch as claim in claim 20, further comprising:

a plurality of second VOICs, each connected between the multiplexer output port of a respective one of the wavelength division multiplexers and the corresponding splitter, for controlling the intensity of multiplexed switched optical signal exiting the wavelength division multiplexers in accordance with a respective second intensity control signals;

wherein the equalizer is further adapted to generate the second intensity control signals as a function of the power estimates.

48. (Original) A switch as claimed in claim 20, further comprising:

a plurality of second VOICs, each connected to the demultiplexer input port of a respective one of the wavelength division demultiplexers connected to the switching core, the second VOICs being arranged to control the intensity of multiplexed switched optical signals entering the wavelength division demultiplexers in accordance with respective second intensity control signals;

wherein the equalizer is further adapted to generate the second intensity control signals as a function of the power estimates.

49. (Original) A switch as claimed in claim 20, further comprising:

a plurality of second optical splitters, each being optically connected to the demultiplexer input port of a respective one of the wavelength division demultiplexers and being arranged to tap a fractional amount of light carrying a respective unswitched wavelength division multiplexed signal;

a plurality of second VOICs, each being optically connected between a respective second optical splitter and the corresponding wavelength division demultiplexer and being arranged to

control the intensity of the respective unswitched wavelength division multiplexed signal in accordance with a respective second intensity control signal; and

a wide-optical-bandwidth power estimation unit connected to the second optical splitters, for estimating the average optical power of the unswitched wavelength division multiplexed signals;

wherein the equalizer is adapted to generate the second intensity control signals as a function of the power estimates received from the wide-optical-bandwidth power estimation unit.

50. (Original) A switch as claimed in claim 20, further comprising:

a plurality of second VOICs, each being optically connected to the demultiplexer input port of a respective one of the wavelength division demutiplexers and being arranged to control the intensity of a respective unswitched wavelength division multiplexed signal in accordance with a respective second intensity control signal;

a plurality of second optical splitters, each being optically connected between a respective one of the second VOICs and the corresponding wavelength division demultiplexer and being arranged to tap a fractional amount of light carrying the respective unswitched wavelength division multiplexed signal; and

a wide-optical-bandwidth power estimation unit connected to the second optical splitters, for estimating the average optical power of the unswitched wavelength division multiplexed signals;

wherein the equalizer is adapted to generate the second intensity control signals as a function of the power estimates received from the wide-optical-bandwidth power estimation unit.

51. (Original) A switch as claimed in claim 50, further comprising:

a reference optical path comprising a reference optical receiver connected in series with a reference power estimation unit, the reference power estimation unit having an output connected to the processor; and

a reference light source having an output coupled to each unswitched wavelength division multiplexed signal at the input of the wide-optical-bandwidth power estimation unit and also being coupled to an input of the reference optical receiver.

52. (Original) A system as claimed in claim 51, wherein the reference light source is connected to the processor by a control link and wherein the processor is further adapted to:

obtain from the reference power estimation unit a reference estimate of the optical power of the reference light source;

apply control to the wide-optical-bandwidth power estimation unit in order to obtain an estimate of the optical power of each unswitched wavelength division multiplexed signal;

determine a calibration factor for each unswitched wavelength division multiplexed signal by evaluating the function of (I) the reference estimate and (II) the power estimate of the unswitched wavelength division multiplexed signal; and

adjust the second intensity control signal associated with each unswitched wavelength division multiplexed signal by the associated calibration factor.

53. (Original) A switch as claimed in claim 20, wherein the equalizer comprises:

a front end circuit having a plurality of inputs for receiving the multiplexed switched optical signals, the front end circuit being adapted to controllably admit individual switched optical signals from the multiplexed optical signals;

an optical receiver unit connected to the front end circuit, for converting any admitted individual switched optical signals to electrical signals;

a power estimation unit connected to the optical receiver unit, for time-averaging the electrical signals, thereby to obtain respective estimates of optical power; and

a processor connected to the power estimation unit and to the front end circuit, the processor being adapted to cause the front end circuit to admit selected individual switched optical signals, the processor being further adapted to generate the intensity control signals from the estimates of optical power.

54. (Original) A switch as claimed in claim 53, wherein the intensity control signals are produced sequentially as a time-division-multiplexed intensity control signal, the equalizer further comprising:

a demultiplexer having a data input and a control input both connected to the processor and having a plurality of outputs, for receiving the time-division-multiplexed intensity control signal at the data input and for controllably distributing time-based portions of the time-division-

multiplexed intensity control signal to selected ones of its outputs as a function of the signal received at its control input; and

a latching circuit having a plurality of inputs connected to the outputs of the demultiplexer, a corresponding plurality of outputs connected to the VOICs and a control input connected to the processor, for transferring the value at any one of its inputs to the corresponding output in response to the signal received at its control input and subsequently holding that value.

55. (Original) A switch as claimed in claim 53, further comprising:

a reference path having a reference optical receiver connected in series with a reference power estimation unit, the reference power estimation unit having an output connected to the processor; and

a reference light source for controllably emitting light having a selectable wavelength, the output of the reference light source being coupled to each multiplexed optical signal at the input of the front end circuit and also being coupled to an input of the reference optical receiver.

56. (Original) A switch as claimed in claim 55, wherein the reference light source is connected to the processor and wherein the processor is further adapted to:

obtain from the reference power estimation unit a reference estimate of the optical power of the reference light source without the effect of the front end circuit;

apply control the to front end circuit in order to obtain an estimate of the optical power of the reference light source for each combination of a multiplexed switched optical signal and a wavelength on that signal;

determine a calibration factor for each said combination by evaluating a function of the reference estimate and the power estimate corresponding to said combination; and

adjust the intensity control signal associated with each switched individual optical signal by the calibration factor associated with the particular combination of multiplexed switched optical signal and wavelength corresponding to that switched individual optical signal.

57. (Original) A switch as claimed in claim 55, wherein said reference light source is tunable under control of the processor.

58. (Original) A method of individually controlling the intensity of a plurality of optical carrier signals capable of being switched by a switching core and recombined into wavelength-division multiplexed (WDM) optical signals by a plurality of wavelength division multiplexers, comprising:

tapping a portion of each WDM optical signal after recombination by the multiplexers to produce a respective tapped optical signal;

processing each tapped optical signal to produce an estimate of the power of each optical carrier signal contained in the respective WDM optical signal; and

adjusting the intensity of each optical carrier signal prior to recombination by the multiplexers as a function of the power estimates.

59. (Cancelled).